Quality Assurance
Technical Document 5

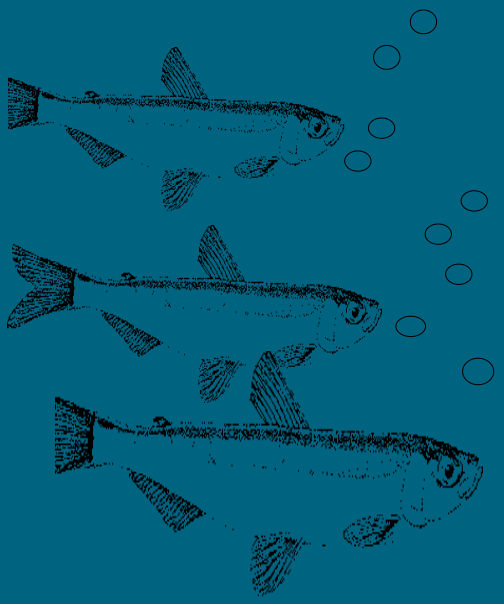
Quality Assurance Management Plan for Environmental Monitoring Programs

June 1998

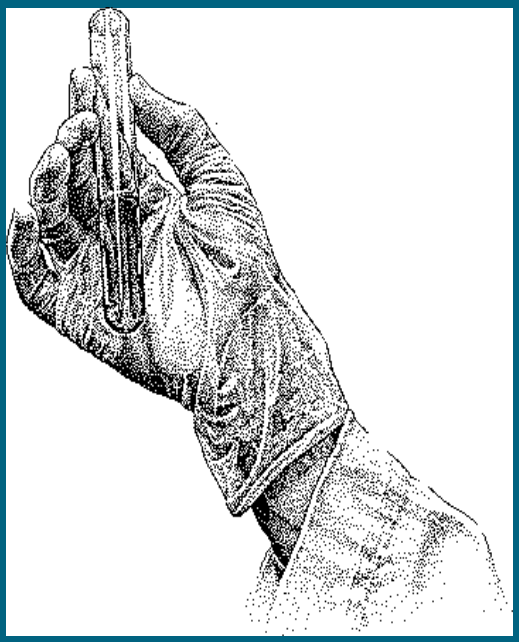
State of California The Resources Agency Department of Water Resources

Department of Water Resources
Quality Assurance/Quality Control Program

Environmental Assessment



Sampling



Analysis

Data Evaluation

State of California
The Resources Agency
Department of Water Resources
Division of Planning and Local Assistance

Quality Assurance Management Plan for Environmental Monitoring Programs

June 1998

Pete Wilson
Governor
State of California

Douglas P. Wheeler
Secretary for Resources
The Resources Agency

David N. Kennedy
Director
Department of Water Resources

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This document reflects the collaborative efforts of many quality management professionals throughout the Department of Water Resources who are participating in the challenge for continuous improvement in quality systems supporting environmental programs. These individuals, who represent the divisions, district offices, field division offices, and laboratories of the Department and who are members of the Quality Control Committee, provide a diverse and broad range of needs and experiences in environmental data collection programs. The contributions and the comprehensive reviews provided by the members of the Quality Control Committee are greatly appreciated. ■

RECOMMEND APPROVAL:

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Date 4/6/98

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Date 4-6-98

Enclosure

Introduction

The development and implementation of the Quality Assurance Management Plan is required by the Department of Water Resources' quality assurance/control policy for environmental monitoring programs. This policy, embodied in Water Resources Engineering Memorandum No. 60, states in part that "The Department shall develop a Quality Assurance Program Plan, approved by the Director, which describes how the Department, through its management organization, intends to consistently produce water-related data of quality which is known and quantifiable. This document will identify goals, organizational structure, individual responsibilities, and management procedures as they relate to implementation and administration of the Quality Assurance/Control Program." WREM No. 60 further states that "Initially, this policy focuses on water-related programs and will evolve to other measurement activities." Consistent with the intent of WREM No. 60, QAMP was developed for application to all environmental monitoring programs.

DWR has developed QAMP as a means of documenting how DWR will plan, implement, and assess the effectiveness of quality assurance and quality control operations applied to DWR's environmental monitoring programs. Specifically, this plan was developed to assure that:

- Environmental data collected by and for DWR are of the appropriate type and quality for their intended use, and
- Technology used for environmental monitoring by and for DWR is designed, constructed, and operated according to defined specifications and protocols.

QAMP, published as DWR's Quality Assurance Technical Document 5, references other DWR quality assurance technical documents for guidance on specific QA/QC principles. Other quality assurance technical documents include:

- *Quality Assurance Guidelines for Analytical Laboratories* (Quality Assurance Technical Document 1): This document provides guidance on selecting and evaluating the performance of laboratories performing chemical analyses for DWR.

- *Sampling Manual for Environmental Measurement Projects* (Quality Assurance Technical Document 2): This document provides technical information on procedures for DWR water-related sampling and data collection activities.

- *Compilation of Federal and State Drinking Water Standards and Criteria (*Quality Assurance Technical Document 3): This document provides a listing of federal and State drinking water standards, criteria, and regulations.

- *Compendium of Water Quality Investigations in the Sacramento-San Joaquin Delta* (Quality Assurance Technical Document 4): This document identifies the agencies that have conducted water quality studies in the Sacramento-San Joaquin Delta.

- *Guidelines for Preparing Quality Assurance Project Plans* (Quality Assurance Technical Document 6): This document provides the guidelines which program managers can use to prepare their project-specific quality assurance project plans.

- *Compilation of Soil and Sediment Standards, Criteria and Guidelines* (Quality Assurance Technical Document 7): This document provides soil and sediment values which can be used to establish data quality objectives for the study and as reference values for comparison of resulting data from soil and sediment analyses.

Copies of these reports can be obtained from DWR's Bulletins and Reports, Post Office Box 942836, Sacramento, California 94236-0001; telephone (916) 653-1097. For further information regarding QAMP, contact:

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Purpose and Scope

Environmental programs conducted by or on behalf of DWR involve many diverse activities that address complex environmental issues. For water-related data alone, DWR annually spends approximately $20 million and 150 person-years of effort in the collection of data for scientific research, permit compliance monitoring, hazardous materials investigations, and policy / program decision-making.

Environmental data are critical inputs to decisions involving the protection of the public and the environment from the adverse effects of pollutants from natural and man-made sources. As key inputs to the decision-making process, environmental data must be accurate and reliable. Compliance with proper QA / QC practices will ensure that the environmental data are accurate and reliable.

It is DWR's policy that all environmental monitoring programs conducted by or on behalf of DWR shall establish and implement effective quality systems to support those programs. This policy is embodied in Water Resources Engineering Memorandum No. 60 and was signed by DWR's Deputy Directors in September 1992. This policy states in part that "The Department shall develop a Quality Assurance Program Plan, approved by the Director, which describes how the Department, through its management organization, intends to consistently produce water-related data of quality which is known and quantifiable. This document will identify goals, organizational structure, individual responsibilities, and management procedures as they relate to implementation and administration of the Quality Assurance / Control Program." WREM No. 60 further states that "Initially, this policy focuses on water-related programs and will evolve to other measurement activities." QAMP provides the blueprint for how DWR will plan, implement, and assess its quality system for all of the environmental monitoring programs of DWR.

QAMP is a management tool that defines how DWR will attain its quality management objectives for environmental monitoring programs. It defines DWR's QA-related policies and procedures, criteria for and areas of application, and roles, responsibilities, and authorities. QAMP has been written to enable managers and supervisors to understand the priority which management places on QA, the established QA policies and procedures, and their respective QA roles. Implementation of QAMP will also permit the determination of whether the quality system is being managed in a way that assures successful environmental monitoring programs.

QAMP describes how DWR plans and implements the necessary QA / QC practices to help management ensure that the results of technical environmental monitoring work are of the type and quality needed for their intended use. Accordingly, QAMP discusses the mission and quality policy of DWR; the specific roles and responsibilities of management and staff with respect to QA / QC activities; the means by which effective communications are assured; the processes used to plan, implement, and assess the work performed; the process by which measures of effectiveness for QA / QC will be established and how frequently effectiveness will be measured; and the process for continuous improvement. Areas addressed within QAMP include:

- Organization and Management
- Roles and Responsibilities
- Personnel Qualifications and Training
- QA / QC Requirements for Contracted Services, Equipment, and Supplies
- Documentation and Records
- Data Reporting, Reduction, Processing, and Storage
- Planning and Implementation of Environmental Monitoring Projects
- Assessment and Response
- Quality Improvement

Finally, because of its importance, QAMP must be kept current and readily available to all managers and staff responsible for planning and implementing environmental monitoring programs. It is anticipated that QAMP will be reviewed and updated at least annually to ensure the effectiveness of DWR's approved QA / QC management practices. ■

Organization and Management

DWR's Quality Assurance/Control Policy

WREM No. 60, approved and issued by DWR's Deputy Directors in September 1992, established DWR's QA/QC policy for environmental monitoring programs. The policy states that DWR shall:

1. Integrate quality control procedures into environmental monitoring activities, including collection, analysis, validation, reporting, storage (retention), and dissemination of data, through implementation of standardized procedures, adequate documentation, and training of DWR employees.

2. Develop a QAMP, approved by the Director, which describes how DWR, through its management organization, intends to consistently produce environmental data of a quality which is known and quantifiable.

3. Assign a QA Officer responsible for administering DWR's overall QA/QC Program in compliance with the approved QAMP.

4. Develop Quality Assurance Project Plans for individual environmental monitoring projects. Data quality objectives will be defined in the Quality Assurance Project Plans.

5. Require all in-house and contract laboratories to follow the U.S. Environmental Protection Agency approved analytical procedures or equivalent, which contain quality control requirements for laboratory operation.

6. Implement quality control procedures in the most cost-effective manner without compromising data quality objectives.

In support of DWR's QA/QC policy, WREM No. 60 also includes requirements for:

1. The development of, and attendance at, training courses for implementation of quality control practices within DWR.

2. The establishment of a Quality Control Committee to help guide DWR's implementation of quality control practices.

3. Periodic reports to the Director on the progress of DWR's implementation of the QA / QC Program and recommendations for further management actions to fully implement the policy.

Organizational Structure and Communication

The QA / QC policy, as established through WREM No. 60, is a departmentwide policy affecting all environmental monitoring programs conducted by or on behalf of DWR. As such, ultimate authority for policy-making lies with the Director.

The Quality Control Committee, as established and directed by WREM No. 60, is responsible for providing guidance on DWR's implementation of quality control practices. The Committee comprises representatives from the Division of Planning and Local Assistance, Division of Operations and Maintenance, Office of State Water Project Planning, Environmental Services Office, Division of Land and Right of Way, Division of Engineering, Division of Safety of Dams, and Division of Management Services. The Quality Control Committee meets quarterly. As part of providing guidance on quality control practices, committee members also review and evaluate Quality Assurance Technical Documents, participate in performance and system audits of DWR environmental monitoring programs and projects, and assist in arranging and conducting training courses.

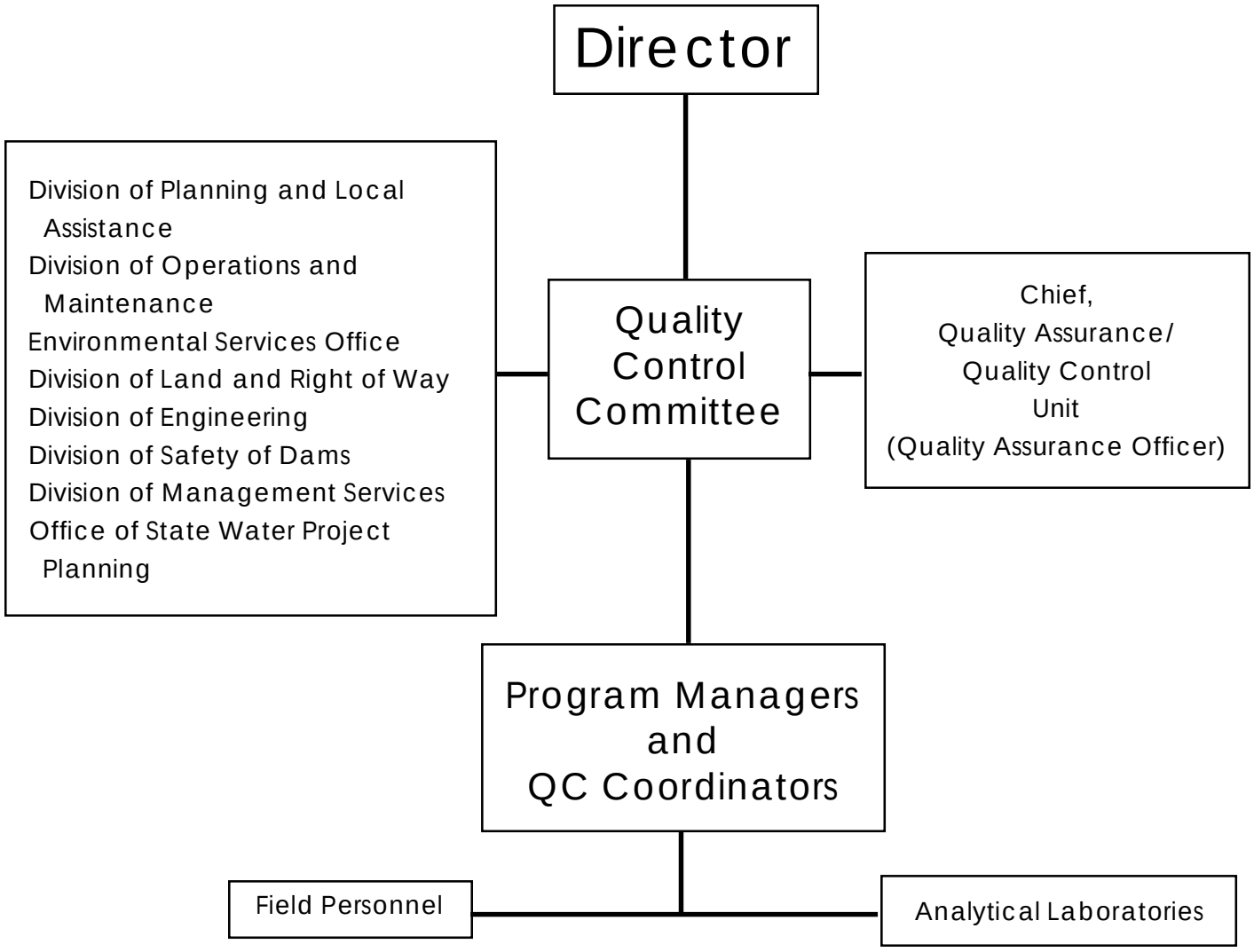
DWR's Quality Assurance Officer is the Chief of the Quality Assurance / Quality Control Unit of the Division of Planning and Local Assistance, and is responsible for chairing the Quality Control Committee and administering DWR's overall QA / QC Program in compliance with the approved QAMP. The Quality Assurance Officer is also responsible for preparing reports to the Director on the progress of DWR's implementation of the QA / QC Program and recommendations for further management actions to fully implement the policy. The administrative activities of the Quality Assurance Officer include the development and coordination of training courses and oversight activities.

Through the guidance of the Quality Control Committee and the Quality Assurance Officer, procedures for implementation of quality control practices are transmitted to all Program Managers within DWR. All Program Managers are responsible for ensuring that appropriate quality control practices are implemented within each of their environmental monitoring projects.

Each environmental monitoring program should have a Quality Control Coordinator designated by the Program Manager. Through the Program Manager and the QC Coordinator, appropriate quality control practices are implemented by the sampling teams and analytical laboratories.

Figure 1 illustrates the organizational structure for communications and responsibilities of DWR's overall QA / QC Program. ■

Figure 1
DWR QA/QC Program
Organizational Structure and Communication



Roles and Responsibilities

Quality Control Committee

The Quality Control Committee is responsible for providing guidance and assistance to DWR in the implementation of QA / QC activities. The committee meets quarterly to plan and discuss activities related to the review and evaluation of:

- Quality assurance technical documents
- Quality assurance project plans
- Sampling and chemical analytical procedures
- Performance of monitoring equipment
- Quality control of data management

The committee also participates in performance and system audits of DWR environmental monitoring programs and projects and assists in arranging and conducting training courses. Finally, the committee participates in making recommendations for improvements to the QA / QC Program.

Quality Assurance Officer

The Quality Assurance Officer is responsible for administering DWR's overall QA / QC Program in compliance with the approved QAMP. The administrative activities of the QA Officer include:

- Development and coordination of training courses and oversight activities
- Preparation of reports to the Director on the progress of DWR's implementation of the QA / QC Program and recommendations for improvements to the QA / QC Program

- Coordination of all QA / QC Program activities within DWR
- Assurance of compatibility and compliance of DWR QA / QC activities with other federal and State QA / QC requirements
- Chairing of the Quality Control Committee
- Review and evaluation of new QA / QC concepts and suggested changes to the QA / QC program
- QA / QC oversight of all analytical laboratories which provide environmental analyses for DWR in accordance with procedures specified in *Quality Assurance Guidelines for Analytical Laboratories* (Quality Assurance Technical Document 1)

Program Manager

Program Managers of DWR environmental monitoring programs are responsible for developing and implementing applicable and appropriate QA / QC practices. Program Managers are also responsible for assuring that:

- Appropriate Quality Assurance Project Plans are developed and implemented in accordance with the procedures specified in *Guidelines for Preparing Quality Assurance Project Plans* (Quality Assurance Technical Document 6) or other guidelines as appropriate
- Sampling activities comply with appropriate QA / QC procedures in accordance with the procedures specified in *Sampling Manual for Environmental Measurement Projects* (Quality Assurance Technical Document 2) or other procedures as apropriate
- Analytical laboratories providing environmental analyses comply with appropriate QA / QC procedures
- Appropriate QA / QC information is included in environmental monitoring program reports

Finally, the Program Manager is responsible for determining QA / QC training needs for program staff, documenting identified QA / QC problems and implementing corrective procedures, and conducting QC audits within the program as necessary.

Quality Control Coordinator

The Quality Control Coordinator within each environmental monitoring program, as designated by the Program Manager, is responsible for developing and implementing Quality Assurance Project Plans. In fulfilling this responsibility, the QC Coordinator develops appropriate data quality objectives and standard operating procedures. The QC Coordinator also assists the Program Manager in assuring that analytical laboratories and sampling activities comply with appropriate QA / QC procedures. In addition, the QC Coordinator assists the Program Manager in:

- Reporting appropriate QA / QC information in environmental monitoring reports
- Determining QA / QC training needs for program staff
- Documenting identified QA / QC problems and implementing corrective procedures
- Conducting QC audits within the program as necessary ■

Personnel Qualifications and Training

All personnel involved in environmental monitoring programs are expected to be familiar with and comply with the principles in the Quality Assurance Management Plan and the respective Quality Assurance Project Plans.

Field sampling teams should be adequately trained to follow appropriate procedures for field sampling and analysis, to know what documentation is required, and to know when a corrective procedure is necessary. The Program Manager is responsible for ensuring that members of the sampling team are adequately trained.

Laboratory personnel should have the appropriate education, training, and experience in the specific area of work. The laboratory director or manager is responsible for ensuring that all laboratory personnel are adequately trained.

Two types of QA training programs are available for DWR employees involved in environmental monitoring activities:

1. Informal ongoing training within each program provided by the Program Manager or the Quality Control Coordinator which includes a field training program for field personnel

2. Periodic formal classroom training sessions arranged by DWR's Quality Assurance Officer

Program Managers should maintain adequate records and documentation of training courses and other training programs attended by employees. In addition, Program Managers should regularly assess employees' knowledge and competence in the use of appropriate QA / QC procedures and determine employees' training needs.

QA/QC Contracting Requirements

Contract Laboratories

DWR's Laboratory Services Policy, as explained in *Quality Assurance Guidelines for Analytical Laboratories* (Quality Assurance Technical Document 1), established joint authority to develop master contracts with commercial laboratories and to maintain continuing assessment and control of the quality of work performed by contract laboratories with Bryte Chemical Laboratory and the QA/QC Program within the Division of Planning and Local Assistance. Consistent with the policy, all departmental requests for analytical services are submitted to Bryte Chemical Laboratory. Bryte Chemical Laboratory maintains the responsibility for distributing the analytical workload to make efficient use of departmental and contract laboratories' resources and capabilities.

Contract laboratories are required to be certified by the Environmental Laboratory Accreditation Program of the California Department of Health Services. Exceptions may be considered where an analytical method is not certified by ELAP. Furthermore, a contract laboratory may not subcontract any analytical work without prior approval by DWR. All subcontracted laboratories must meet all certification and quality control requirements of the contract laboratory.

Equipment and Supplies

Program Managers are responsible for ensuring that specified quality standards are met by all equipment and supplies procured for use in environmental monitoring programs. Program Managers are also responsible for testing and inspecting the purchased items upon receipt to ensure that the items are certified and functioning properly. Evaluations of quality standards for environmental monitoring equipment and supplies are conducted both before and after the selection process.

The procurement process includes the following basic steps to ensure that the purchased items meet the needs of the environmental monitoring program and are of acceptable quality:

1. Planning of procurement needs and activities

2. Identification, documentation, review, and approval of technical specifications

3. Selection and documentation of evaluation criteria and necessary certifications

4. Identification of procedures for review and approval of negotiations, compromises, or changes regarding technical issues

5. Documentation of the procurement process

6. Evaluation and verification of postaward quality versus original acceptance criteria

Ongoing activities directed towards assurance of quality standards for suppliers of equipment and supplies include evaluating procurement sources prior to selection, evaluating objective evidence of quality furnished by the supplier, inspecting procurement sources, auditing suppliers, and examining deliverables. ■

Documentation and Records

Program Managers are responsible for ensuring that all documentation and records pertaining to their environmental monitoring programs are maintained and properly stored so that the information is readily retrievable for review and inspection. Records and documents which should be retained include, but are not limited to:

- Laboratory data reports
- Laboratory quality control reports
- Chain of custody forms
- Field logs
- Instrument printouts
- Results of calibration and QC checks
- Field sampling case narratives
- Laboratory analysis case narratives
- All information and records which are included in a project-specific data report package
- Quality assurance project plans
- Sampling and analysis plans
- Standard operating procedures
- Personnel training records
- Results of audits and reviews

All laboratories providing analytical services for DWR are responsible for retaining all appropriate records and documents which include, but are not limited to:

- Quality assurance manuals
- Personnel training records

- Results of certification surveys and evidence of certification by appropriate regulatory or accreditation agencies
- Standard operating procedures
- Receiving documents such as chain-of-custody records and sample integrity reports
- Stock standard logs
- Calibration records for analytical instruments, balances, thermometers, and other equipment
- Internal quality control checks such as laboratory control samples, method blanks, matrix spikes, and surrogate recoveries
- Analytical control charts and out-of-control reports
- Results of performance and system audits

For the overall QA / QC Program of DWR, the Quality Assurance Officer and the Quality Control Committee are responsible for retaining all appropriate documents and records which include, but are not limited to:

- All QA / QC policies and procedures, and subsequent updates to QA / QC policies and procedures
- Results of audits of QC procedures of environmental monitoring programs within DWR
- Minutes of Quality Control Committee meetings
- Documentation of QA / QC problems and corrective actions taken

Data Management

Data Reporting, Reduction, Processing, and Storage

All laboratories providing analytical services for DWR are responsible for providing all necessary data, including all quality control data, in electronic formats required by DWR. These data include, but are not limited to:

- Precision of replicate measurements
- Accuracy of measurements
- Descriptions of analytical methods and reporting limits
- Blank and recovery measurements
- Sample handling documentation to ensure adherence to method holding-time limits

Each Program Manager is responsible for ensuring that all appropriate field data are documented in appropriate field or log sheets utilized by the environmental monitoring program. An example of a field sheet is contained in *Sampling Manual for Environmental Measurement Projects* (Quality Assurance Technical Document 2). In addition, appropriate protocols should be established for processing data from continuous recorders and other types of automated data recording equipment, which may include procedures for reformatting, summarizing, and other data manipulation. Finally, Quality Assurance Project Plans should indicate how specific types of data will be stored with respect to the type of media, conditions, location, retention time, and access.

Each Program Manager is also responsible for ensuring that data are validated through a systematic process of reviewing data against established criteria. This process is conducted to ensure the validity of the data prior to its use, and consists of evaluating the quality and reliability of data from both field measurements and laboratory analyses. Validation of field data

involves verification of appropriate collection, preservation and transport protocols, and the use of duplicates and reference samples. Validation of laboratory data involves review of checks on precision and accuracy (such as duplicate sample analyses, reference samples, matrix spike samples, and laboratory control samples), evaluation of blanks, interlaboratory comparisons, and instrument calibration data.

Finally, each Program Manager is responsible for correct processing of acceptable data, using appropriate mathematical, statistical, and graphical procedures to convert raw environmental data into usable information. This data reduction process may consist of changes in form or expression of the data, quantity of data values, or numbers of data items. Errors in data reduction should be eliminated through use of appropriate quality control procedures, including procedures for reviewing and checking of data. ■

Planning and Implementation

Planning and Implementation of Environmental Monitoring Projects

Program Managers are responsible for ensuring that environmental monitoring projects are systematically planned and implemented, and that the planning and implementation process is documented in Quality Assurance Project Plans. The planning process must ensure that all organizations and parties who contribute to the quality of the environmental program or use the results are identified and that they participate in the planning process. That process should include direct communications to ensure that all participants clearly understand the needs and expectations of the end users and the results.

The generation, acquisition, and use of environmental data should be planned using a systematic planning process which will:

1. Identify the parties for which the work is to be performed

2. Identify the needs and expectations of the parties in terms of both technical and quality goals

3.. Translate the parties' needs into specifications to produce the desired result

4. Consider each project's cost and schedule constraints

5. Identify acceptance criteria for the result or measures of performance by which the parties' satisfaction will be determined

The four basic elements for planning and implementing environmental monitoring projects that should be included in Quality Assurance Project Plans include:

- Project management
- Measurement / data acquisition
- Assessment and oversight
- Data validation and usability

Detailed descriptions of these basic elements may be found in *Guidelines for Preparing Quality Assurance Project Plans* (Quality Assurance Technical Document 6). ■

Assessment and Response

Assessments of environmental monitoring programs should be conducted periodically to examine the level of performance and quality within the programs and to provide a basis for improving the programs. Assessment tools for environmental monitoring programs include:

- Management system reviews
- Surveillances
- Quality audits
- Performance evaluations
- Audits of data quality
- Peer reviews and technical reviews
- Readiness reviews
- Data quality assessments

Program Managers are responsible for ensuring that their environmental monitoring programs are periodically reviewed and assessed using one or more of the assessment tools listed above.

The most frequently used assessment tool is the quality audit. There are generally two types of quality audits:

1. Performance audit—evaluates a laboratory's ability to provide accurate results. This type of audit is usually carried out through use of performance evaluation samples or standard reference materials. Laboratory performance can also be evaluated through interlaboratory comparison studies in which analytical results for replicate samples are sent to several laboratories for comparison.

2. Systems audit—evaluates the actual operational details. A systems audit can be used to evaluate both field and analytical procedures. Field audits verify that sample collection, preser-

vation, shipping, and associated procedures are consistent with those specified in approved Quality Assurance Project Plans. Laboratory audits verify that the facility's operational procedures and analytical processes are consistent with established acceptable criteria.

The Quality Control Committee and the Quality Assurance Officer may, when deemed necessary or at the request of Program Managers, conduct reviews and assessments of any or all DWR environmental monitoring programs using any of the listed assessment tools.

Corrective procedures will be required when a performance failure is discovered or when quality audits reveal deficiencies. Corrective procedures may include identifying faulty equipment or procedures, providing additional training to personnel, and resampling and reanalysis of samples.

Each Program Manager is responsible for implementing corrective procedures. In addition, the Program Manager should maintain appropriate documentation of quality assurance problems, corrective actions taken, and their results or outcomes.

The quality control officer of each laboratory providing analytical services for DWR is responsible for implementing laboratory corrective procedures when necessary. Different types of corrective procedures may be required depending on the analytical procedure. These corrective procedures should be documented in the analytical method and in the laboratory's Quality Assurance Manual. ■

Quality Improvement

The process of continuous quality improvement leads to the development of a better and more responsive quality system. Quality improvement generally results from activities that:

- Prevent or minimize problems during the planning and implementation of environmental programs that may affect the quality of the results
- Detect and correct problems
- Review existing performance and identify opportunities for quality improvement

There are two levels of continuous quality improvement activities:

1. Each Program Manager is responsible for planning, implementing, and maintaining a system of continual assessments and corrective procedures of their individual environmental monitoring programs to examine and improve the level of performance and quality within the programs. These program-specific continuous improvement activities are required components of each program's planning and implementation process. At the program level, the Program Manager may utilize any or all assessment tools listed in the “Assessment and Response” chapter.

2. The Quality Control Committee and the Quality Assurance Officer are responsible for planning, implementing, and maintaining a system of continual assessments and corrective procedures for all environmental monitoring programs within DWR at a broader level. While the assessment tools utilized at this level are generally the same as those used at the program level, the Quality Control Committee and the Quality Assurance Officer plan and perform these continuous improvement activities to:

- Evaluate the overall quality performance of all environmental monitoring programs of DWR
- Identify problems with quality performance which are not within the control of, or resolvable at, the program level
- Provide continual general oversight of quality performance of all environmental monitoring programs of DWR
- Develop and implement appropriate Departmental QA/QC policies and procedures applicable to all Departmental environmental monitoring programs

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